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Electric Motors and Drives

Electric motors vary greatly in performance. The selection of energy-efficient motors for HVAC equipment and other applications in existing or new facilities can greatly reduce energy consumption. Recent developments in energy-efficient motors and motor controls allow facility managers to significantly reduce energy consumption in some Federal facilities.

Opportunities

For new facilities, high-efficiency motors should be specified during design. In existing facilities, facility managers should inventory all motors, beginning with the largest and those with the longest run-times. This inventory permits informed decision-making about replacement, either before or after motor failure. Field-testing of motors enables the facility manager to properly size replacements to match the actual driven load. The software mentioned in this section can help with this inventory.

Technical Information

The Motor Challenge Program was developed by DOE to assist industrial customers in increasing their use of energy-efficient motor systems. Federal facility managers can also benefit from Motor Challenge through a special arrangement with FEMP, receiving technical assistance, training, software, and other materials.

MotorMaster+ is a PC-based software tool that helps the user to inventory and select motors. A database of 12,000 new motors contained in the software includes horsepower, speed, enclosure type, manufacturer, model name, catalog number, voltage, nominal efficiencies at various loads, torque and current characteristics, power factor, warranty, and list price. The software allows users to simulate replacement scenarios to determine the lowest life-cycle cost options for existing motors.

The inventory features in **MotorMaster+** help facility managers track motors, including their location, and electrical measurements needed to determine loading. Developing an inventory is the first step in establishing a motor rewind/replacement policy that could



This high-efficiency motor is designed to work with a variable-frequency drive.

Photo: General Electric

significantly reduce operating expenses. Since motors are typically replaced or rewound when the motor fails, having an inventory will allow facility managers to quickly determine the most economical approach to take and assist in proper equipment selection. Inventoried motors also can be evaluated to set priorities for the replacement of functioning motors with premium-efficiency motors.



Turn off unneeded motors. Identify motors that operate unnecessarily, even for a portion of the time they are on. For example, waste may occur with multiple HVAC circulation pumps operating even when demand falls, cooling-tower fans operating when target temperatures are met, ceiling fans operating in unoccupied spaces, exhaust fans operating after ventilation needs are met, and escalators operating after closing time. In all these cases, simply turning off the motors can produce significant energy savings.

Reduce motor system usage. Building design, maintenance, and operation can greatly affect the run-time of motors. For example, reducing cooling loads in a building will reduce the amount of time air handler motors need to operate. The following is a list of strategies for reducing the use of motors.



REDUCE MOTOR SYSTEM USAGE

- **Reduce loads on HVAC systems:**
 - Improve building shell energy performance.
 - Improve HVAC performance.
 - Check refrigerant charge.
- **Reduce refrigeration loads:**
 - Improve insulation.
 - Add strip curtains on doors.
 - Calibrate control setpoints.
 - Check refrigerant charge.
- **Check ventilation systems for excessive air:**
 - Reseal fan if air is excessive.
 - Downsize motors if possible.
- **Improve compressed-air systems:**
 - Locate and repair compressed-air leaks.
 - Check air-tool fittings for physical damage.
 - Turn off air to tools when not in use.
- **Repair duct leaks.**

Sizing motors is important. Do not assume that an existing motor is properly sized for its load, especially when replacing it. Many motors operate most efficiently at 75–85% of full-load rating. Undersizing or oversizing reduces efficiency. For large motors, facility managers may want to seek engineering help in determining the proper sizes and actual loadings of existing motors. There are several ways to estimate actual motor loading: the kilowatt technique, the amperage ratio technique, and the less-reliable slip technique. All three are supported in the *MotorMaster+* software.

Instead of rewinding small motors, consider replacing them with energy-efficient models. For larger motors, if rewinding offers the lowest life-cycle cost, select a rewind facility with high quality standards to ensure that motor efficiency is not adversely affected. For sizes of 10 hp or less, new motors are generally less expensive than rewinding. When standard-efficiency motors under 100 hp have failed, scrapping them is usually the most cost-effective option, provided that they have had sufficient run-time and are replaced with energy-efficient models.

References

Energy-Efficient Electric Motor Handbook, Revision 3, U.S. Department of Energy, Washington, DC, 1993.

Hoslida, Robert K., “Electric Motor Do’s and Don’ts,” *Energy Engineering*, Vol. 19, No. 1.

Nadel, Steven, et al., *Energy-Efficient Motor Systems: A Handbook on Technology, Programs, and Policy Opportunities*, American Council for an Energy-Efficient Economy, Washington, DC, 1991.

Drivepower Technology Atlas, E Source, Inc., Boulder, CO, 1996; (303) 440-8500; www.esource.com.

Contacts

FEMP offers training to facility managers on the use of *MotorMaster+* software and other motor system management topics. Contact the FEMP Help Desk at (800) DOE-EREC (363-3732), or see the FEMP Web site at www.eren.doe.gov/femp/.

MotorMaster+ 3.0 can be downloaded or used online: mm3.energy.wsu.edu/mmplus/.

DOE’s Motor Challenge Hotline, (800) 862-2086, provides information, software, and publications.

The Motor Challenge Web site, www.motor.doe.gov, includes discussion forums, frequently asked questions, and application information.